

Factors influencing farmers' responses to welfare legislation: A case study of gestation sow housing in Flanders (Belgium)

Frank A.M. Tuytens^{a,*}, Ester Struelens^{a,1}, Suzy Van Gansbeke^b, Bart Ampe^c

^a *Animal Husbandry and Welfare, Animal Sciences, Institute for Agricultural and Fisheries Research, Scheldeweg 68, 9090 Melle, Belgium*

^b *Department of Agriculture and Fisheries, Sustainable Agricultural Development Division, B. van Gansberghelaan 115A, 9820 Merelbeke, Belgium*

^c *Department of Physiology and Biometrics, Faculty of Veterinary Medicine, Ghent University, Salisburylaan 133, 9820 Merelbeke, Belgium*

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Abstract

In the light of the EU ban on individual confinement of gestating sows which will have to be fully implemented by 2013, a survey was conducted among a representative sample of Flemish pig producers. The questionnaire was sent by post to 250 farmers in 2003 and 352 farmers in 2005 of which 219 and 296, respectively, provided valid responses via telephone. The percentage of respondents housing (some of) their sows in group was 10.5% in 2003 and 16.2% in 2005. These farmers were more likely to have a successor than farmers housing their sows individually. The most common group housing systems were free access stalls (24%) followed by electronic feeding stations (21%), ad libitum feeding (20%), feeding stalls/troughs (18%), and drop/trickle feeding systems (13%). Interval (4%) and electronic feed dispensers (0%) were very rare in Flanders. The main criteria for having chosen a particular group housing system related to sow health and welfare, investment costs and amount of labour. The relative importance of economic reasons has increased over time. Users were generally rather satisfied with their group housing system. Farmers using group housing for all their sows were more satisfied than farmers using both group and individual housing. Users of ad libitum feeding systems (and feeding stalls/troughs) were more satisfied than users of electronic feeding stations. A minority of respondents was planning to change to group housing within two years time (4.1% in 2003 and 7.4% in 2005). These tended to be young farmers with a large sow herd and 58% reported to opt for free access stalls. The main reason why the remaining respondents were not planning to change to group housing yet is that they will stop farming activities before 2013. This reason was particularly important for older small-scale farmers without a successor. In contrast, the lack of financial resources and security was particularly important for young farmers of a large sow herd with a likely successor. An increasing group of farmers (often without a successor) reported to delay changing to group housing because they consider individual housing more profitable. These results show that, in Flanders, the conversion to group housing is taking place slowly, that the reasons for not converting yet vary according to the farmers' age, the likelihood of a successor and herd size, and that there are differences between operational group housing systems concerning herd size, age of the system, sow management and user satisfaction.

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* Corresponding author. Tel.: +32 9 272 26 05; fax: +32 9 272 26 01.

E-mail address: frank.tuytens@ilvo.vlaanderen.be (F.A.M. Tuytens).

¹ Present address: University College Ghent, Faculty of Biosciences and Landscape Architecture, Brusselsesteenweg 161, 9090 Melle, Belgium.

1. Introduction

For Belgium and many other European countries, one of the most important articles of EU directive 2001/88/EC concerning the minimum standards for the protection of pigs is the one stating that sows must be kept in groups from 4 weeks after service to 1 week before farrowing. This provision applies to all holdings newly built or rebuilt from 2003, and to all other holdings in which at least 10 sows are raised from 2013. The EU Scientific Veterinary Committee (1997) recommended that, as social animals, pigs should not be housed individually except for mature boars and sows at farrowing. Although better management and stockmanship skills may be required, keeping sows in groups and giving them freedom of movement is commonly – but not universally (e.g. Barnett et al., 2001; McGlone et al., 2004) – believed to improve their welfare compared with housing them individually (Broom et al., 1995; Marchant et al., 1997; Bracke et al., 1999, 2002). In North America, individual sow housing is also losing favour but the change is driven by market forces (corporations like Smithfield Foods, Maple Leaf, Burger King and Cargill Pork decided to discourage or phase out individual housing systems) rather than direct legislation.

During the last 50 years, commercial sow housing systems have undergone considerable transition in Belgium just as in most other developed countries around the world. Before the 1960s sows were predominantly housed in groups (Maton et al., 1985). Between 1960 and 1970 group housing systems were extensively replaced by individual stalls, as the latter were more profitable and efficient (Daelemans, 1998). Up to the present, the individual stall is the most common housing system for sows in Belgium. However, 89.8% of Belgians consider this type of housing as cruel and 83.5% support the EU ban on individual sow housing (De Letter, 2001). In the

late 1980s group housing systems with electronic feeding stations were introduced onto the Belgian market, but competing with individual stalls appeared difficult. In contrast, in some other European countries such as Sweden, Switzerland and the UK, group housing systems already became relatively common since the 1990s (Bartussek et al., 2000).

Nowadays a wide variety of modern group housing systems differing in e.g. feeding system, group size, use of litter, flooring, and space allocation are used in these countries. In countries with a small-scale agricultural structure like Austria, Switzerland and Southern Germany, housing systems for small groups are widespread, whereas in Denmark, Sweden, the United Kingdom and the Netherlands sows are frequently housed in groups of 40–500 sows as well (Bartussek et al., 2000). Van Gansbeke (2006) classified the most relevant systems (for Belgium) in six categories according to the following criteria: (1) whether or not sows are completely physically separated from each other during feeding, (2) whether or not the ration can be adjusted individually, (3) whether or not all sows in the group can eat simultaneously; (4) whether or not the feed ration/intake is restricted. For the sake of this study we have refined this classification to seven categories by adding a fifth criterion, viz. (5) whether feeding is automated or manual (Table 1). Detailed information about different group housing systems for gestating sows is given by Den Hartog et al. (1993), Gonyou (2003) and Van Gansbeke (2006).

Pig producers have little reliable information at their disposal, however, to choose between these different types of group housing systems. Despite some valuable comparisons with regards to animal welfare (Krause et al., 1997; Bartussek et al., 2000; Bracke et al., 2002; Hulbert and McGlone, 2006), ammonia emissions (Groenestein et al., 2001), labour (Roelofs and Van de Sande Schellekens, 1996) and economic performance

Table 1

Classification of seven group housing systems currently used for sows in Belgium based on five criteria (adapted from Van Gansbeke, 2006)

Type of group housing system	Physical separation during feeding	Individualised ration	All sows can eat simultaneously	Feed restriction	Automated feed delivery
1. Drop/trickle feeding	Partial (no)	No	Yes	Yes	Yes
2. Electronic feeding station	Complete	Yes	No	Yes	Yes
3. Free access stalls	Complete	No	Yes	Yes	No/yes
4. Ad libitum feeding	No	No	No	No	No/yes
5. Electronic feed dispensers	No	Yes	No	Yes	Yes
6. Interval feed dispensers	No	No	No	Yes	Yes
7. Feeding stall/trough (manual)	Partial/no	No	Yes	Yes	No

(Backus et al., 1997) very few scientifically robust conclusions can be drawn about the advantages and disadvantages of the various group housing systems. Moreover, such comparisons are complicated by the fact that the success of a housing system depends to a large degree on management and stockmanship. Indeed, pig producers should choose a system that suits them and their herd (Vermeer et al., 2001; Gonyou, 2003). The hands-on experience from farmers who have been keeping sows in group is particularly important information therefore to pig producers who still need to change from individual to group housing as well as livestock scientists. The present survey was conducted since, apart from case-study reports in popular specialised journals or some unpublished reports from foreign institutes, such information is hardly available.

The objectives of this survey were to quantify: (1) the percentage of holdings in Flanders where gestating sows are kept individually versus in group housing; (2) the percentage of holdings where a change to a group housing system is planned within a time-span of two years and the type of group housing that will then be built; (3) the reasons why farmers have not yet changed to a group housing system; (4) the different types of group housing systems that are used in Flanders and the reasons why farmers chose that type of group housing; and (5) the contentment of farmers using a group housing system concerning labour, ease of use, animal welfare, production results, maintenance and running costs.

2. Methods

2.1. Survey procedure

In order to select a random and representative sample of Flemish sow-keepers, the national SANITEL list of all pigs and pig producers in Flanders recorded and kept up-to-date by the Central Animal Health Association was used. In October 2002 this record counted 9682 pig producers of which 5806 had >1 sow. At the beginning of 2005 the latter number had decreased to 5152 farmers. Out of these farmers, we randomly selected 250 and 352 farm-locations for the 2003 and 2005 surveys respectively. The 2005 sample did not include farmers that had been contacted already in 2003. The questionnaire and an accompanying letter were sent to the person owning these holdings, urging them to fill in the questionnaire and to keep it near the phone. About 1 week later they were contacted by telephone in order to collect the answers. If we failed to reach them during that week, we kept on trying for the duration of 1 month, phoning at different times of the day. By contacting them by telephone, we aimed to maximise co-operation, and hence the response rate. Moreover, the poll-taker could check whether the questions had been well understood and that the

answers made sense. The poll-taker was instructed to be extremely cautious not to influence the interviewee.

2.2. The questionnaire

The questionnaire consisted of three clearly distinct parts. Part I had to be filled in by all respondents and concerned general data about the farmer (date of birth) and farm (farrow to finish farm versus breeding farm, likelihood of a successor, number of sows). Farmers using a group housing system for (some of) their sows were asked to proceed to Part II, and farmers having detailed plans to change to a group housing system within a time-span of maximum two years were asked to proceed to Part III. All other farmers were asked to allocate 100 points according to the relative importance of the reasons for having no intentions yet to change to a group housing system (Table 2).

In Part II farmers using a group housing system were asked which type of system they used (Table 1), how long the system

Table 2

Relative importance scores of 13 different reasons for not yet having plans to change to a group housing systems for gestating sows within 2 years time as reported by Flemish pig farmers in the 2003 and 2005 surveys

	2003	2005
<i>Lack of finances and security</i>		
1. Mortgage on current stables won't expire in near future	12.1 (1.7)	10.1 (1.4)
2. Insufficient financial resources	7.5 (1.0)	8.1 (1.0)
3. Uncertainty about the future of the farm	11.1 (1.4)	11.5 (1.4)
4. Uncertainty about future legislation	10.7 (1.3)	8.3 (0.9)
<i>Prefer individual housing</i>		
5. Individual housing is financially more optimal	7.1 (1.2)	6.7 (0.9)
6. Delaying change to group housing is most profitable	9.5 (1.2)	9.3 (1.2)
7. Not ready yet to consider group housing	8.7 (1.2)	15.4 (1.6)
<i>End of career</i>		
8. End of career, quit business before 2013	21.3 (2.7)	18.3 (2.4)
9. Farm will be taken over by someone else before 2013	4.3 (1.1)	2.6 (0.7)
<i>Lack of information</i>		
10. Insufficient information about current legislation	1.8 (0.5)	1.5 (0.3)
11. Insufficient information about group housing systems	4.1 (0.9)	3.2 (0.9)
12. Don't know about a ban on individual confinement	0.7 (0.3)	0.6 (0.2)
<i>Other</i>		
13. Other	0.8 (0.4)	3.2 (1.0)

The values are mean scores (and the standard error of the mean) on a 0–100 scale (respondents divided 100 points among the 13 reasons with more points indicating greater relative importance).

had been operational, the average group size, whether groups were dynamic or static, whether or not litter was provided, whether or not other enrichment was provided, the amount of floor space per sow, the type of group management used (1-, 2-, 3- or 5-week batch system), and the percentage of their sows kept in group housing. They were also asked to score from 1 (not at all satisfied) to 5 (very satisfied) how satisfied they were with their group housing system concerning eight specific criteria (amount of labour, type of labour, ease of use, sow welfare, sow health, production results, mechanical/electronic defects, running costs) and in general. These scores were treated as continuous variables in the analyses. Finally, they were also asked to allocate 100 points according to the relative importance of the various reasons for having chosen a particular type of group housing system: amount of labour, type of labour, zootechnical performance, investment costs, running costs, sow health, sow welfare, proven quality, and other.

The latter question was also asked to farmers planning to convert to a group housing system for (some of) their sows within the next two years (Part III). In addition, these farmers were asked whether it concerned renovation works or a newly built unit, which type of group housing system they had chosen, and what percentage of their sow herd would be housed in this system.

2.3. Analyses

The results were analysed using SAS 9.1 for windows. Descriptive statistics were mainly used. Binary variables were analysed using a logistic regression model (LR, Proc Logistic). Continuous variables were analysed using a linear model (LM, Proc Mixed). Statistical significance was evaluated at $P=0.05$. For the comparisons between the different types of group housing, all possible pair-wise comparisons were tested at a total significance level of 0.05 using the Tukey–Kramer adjustment for multiple comparisons. To determine four different types of not-converting farmers, a cluster analysis (Proc fastclus) was performed on the variables explaining the reason for not converting. These clusters were used for further analyses. Due to the small sample size, data of 2003 and 2005 were merged into one dataset for most analyses.

3. Results

3.1. Respondents

In both 2003 and 2005 the response rate was very high (Table 3). Two tests indicated that the respondents (“the sample”) were a representative sample of the Flemish pig producers with at least two sows (“the population”). Firstly, in 2003 and 2005 the average number of sows per farm of the population (2003: 117.5 sows; 2005: 122.5 sows) was not significantly different of the average for the sample (2003: $\bar{x}=115.9$ sows, $SE=5.6$, $P=0.77$;

Table 3

Overview of the response rate to the total number of questionnaires sent in the 2003 and 2005 surveys and number (and percentages) of valid respondents with individual versus group housing systems for sows

	2003	2005
No. of questionnaires sent	250	352
No. of faulty addresses	0	6
No. that had quit keeping sows	30	39
No. that could not be contacted	1	7
No. who refused to participate	0	4
No. of valid respondents	219	296
No. with individual sow housing not planning to convert ^a	187 (85.4%)	226 (76.4%)
No. with individual sow housing planning to convert ^a	9 (4.1%)	22 (7.4%)
No. with group housing	23 (10.5%)	48 (16.2%)

^a To a group housing system within two years time.

2005: $\bar{x}=125.1$ sows, $SE=5.6$, $P=0.64$). Secondly, the distribution of the farms across the five Flemish provinces was very similar between the population and the sample.

The respondents were on average 47 (range: 26–85) years old (Table 4). The majority of the respondents owned a farrow to finish farm rather than a breeding herd only. There was a trend for a positive association between farmer’s age and the likelihood of having breeding herds only (LR, $\chi^2_1=2.97$, $P=0.085$). A successor was more likely for breeding herds only than for farrow to finish herds (LM, $F=7.53$, $P=0.006$), and for farms with many sows compared to few sows (LM, $F=14.38$, $P<0.001$). There was a negative association between the age of the farmer and the size of the sow herd (LM, $F=56.29$, $P<0.001$).

3.2. Individual sow housing systems and no change to group housing planned within 2 years

The percentage of farms with individual sow housing and for which conversion to a group housing system was not planned within the next two years decreased from 85.4% in 2003 to 76.4% in 2005 (Table 3). The main reason why these farmers were not planning to change to a group housing system is that the enterprise would be stopped before 2013 when group housing becomes compulsory (Table 2). However, the reasons differed considerably between farmers. Cluster analysis revealed that four groups of farmers could be differentiated. For type 1 farmers the end of their farming activities before 2013 was the main reason for not converting to group housing. These type of farmers tended to be older farmers (LM, $F=53.61$, $P<0.001$) without a successor

Table 4

Comparison between three types of sow-farmers: (1) those that use a group housing system, (2) those that use an individual housing system and have no plans to convert to group housing within two years time, and (3) those that use an individual housing system but have plans to convert to group housing within two years time

	Individual housing		Group housing	Total
	No converting plans	Converting plans		
<i>2003</i>				
Mean age farmer	47.6 (0.8)	40.3 (2.5)	46.5 (2.3)	47.2 (0.7)
Likelihood successor ^a	2.6 (0.1)	2.9 (0.1)	3.1 (0.2)	2.7 (0.1)
Mean no. of sows	112.1 (6.0)	193.9 (40.3)	116.0 (12.9)	115.9 (5.6)
% farrow to finish farms	61.5	55.6	60.9	61.2
<i>2005</i>				
Mean age farmer	47.4 (0.7)	40.6 (1.5)	45.8 (1.5)	46.6 (0.6)
Likelihood successor ^a	2.6 (0.1)	2.8 (0.1)	2.9 (0.2)	2.7 (0.1)
Mean no. of sows	116.1 (6.0)	181.0 (20.6)	142.1 (16.9)	125.1 (5.7)
% farrow to finish farms	70.9	81.8	66.7	70.7

The values are the means (and the standard error of the mean) or the percentages.

^a Scored on a scale from 1 (very unlikely) to 5 (very likely).

(LM, $F=32.72$, $P<0.001$) and having a small number of sows (LM, $F=21.85$, $P<0.001$). For type 2 farmers, about half of all farmers (Table 5), the main reasons for not converting to group housing were running loans on their current pig houses, insufficient financial resources, and uncertainty about what the future would bring (both in terms of legislation as of the future about their farming activities). These type of farmers tended to be young farmers (LM, $F=53.61$, $P<0.001$) with a likely successor (LM, $F=32.72$, $P<0.001$) and having a large number of sows (LM, $F=32.72$, $P<0.001$). Type 3 farmers considered it financially more optimal to house sows individually and were not yet open for group housing systems. These type of farmers tended to be farmers without a successor (LM, $F=32.72$, $P<0.001$). The proportion of type 3 farmers was higher in 2005 than in 2003 (Table 5). Finally there was a small group of type 4 farmers who reported that the lack of information concerning the legislation and different types of group housing systems as an important reason for not converting to group housing. These tended to be young farmers (LM, $t=53.61$, $P<0.001$).

3.3. Individual sow housing systems but conversion to group housing planned within 2 years

Table 3 shows that the percentage of farms with individual sow housing but for which conversion to a group housing system was planned within the next two years tended to increase between 2003 (4.1%) and 2005 (7.4%; LR, $\chi^2_1=2.9$, $P=0.086$). The likelihood of having detailed plans to convert to group housing decreased with the age of the farmer (LR, $\chi^2_1=8.2$, $P=0.004$) and

increased with the number of sows on the farm (LR, $\chi^2_1=8.6$, $P=0.003$; Table 4). More than half of these farmers reported that they would convert to a group housing system with free access stalls (Fig. 1). The main criteria for choosing a particular group housing system related to the investment costs, the health and welfare of the sows, and the expected zootechnical performance (Fig. 2).

3.4. Operational group housing systems in Flanders

Table 3 shows that the percentage of respondents housing (some of) their sows in group, tended to rise between 2003 (10.5%) and 2005 (16.2%; LR, $\chi^2_1=3.6$, $P=0.059$). Farmers using a group housing system were more likely to have a successor than farmers housing their sows individually (LR, $\chi^2_1=5.2$, $P=0.023$; Table 4). The type of farm (farrow to finish versus breeding herd), the age of the farmer, and the number of sows did not differ significantly between farms with and without a group

Table 5

Distribution (% of farmers) of four types of Flemish farmers clustered according to their reported reasons for not yet having plans to change to a group housing system for their gestating sows in the 2003 and 2005 surveys

Type and main reason ^a	2003	2005
1: End of career	22.5	15.8
2: Lack of financial resources and security	54.6	49.3
3: Prefer individual housing	20.9	30.0
4: Lack of information	2.1	2.2

^a See Table 2 for the grouping of the 13 specific reasons into four main reasons.

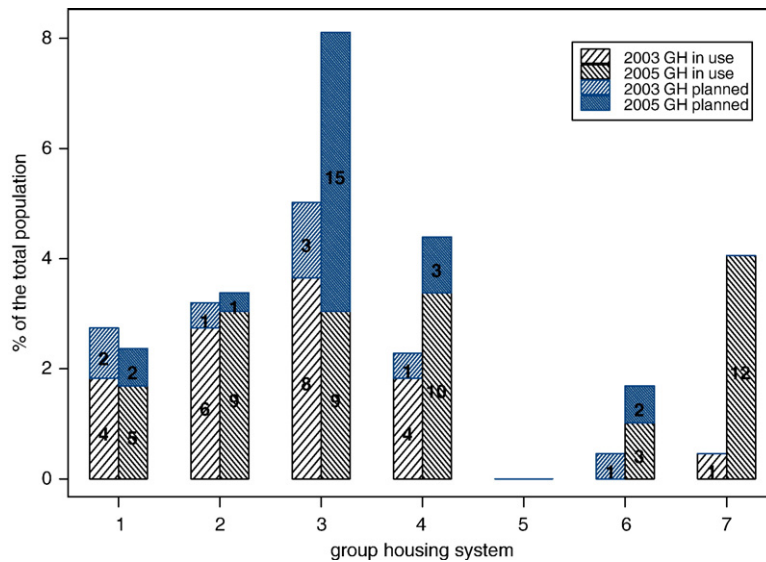


Fig. 1. Occurrence (% relative to total number of respondents) of the different types of group housing systems (see Table 1) used and planned to be built within a time-span of two years in Flanders according to the 2003 and 2005 surveys. The numbers in the histograms are the actual number of farms.

housing system. Litter and environmental enrichment were not commonly provided in group housing systems (Table 6).

The most common group housing systems were free access stalls, followed by electronic feeding stations, ad libitum feeding systems and feeding stalls/troughs with

manual feed delivery (Fig. 1). Interval feeding, and electronic feed dispensers in particular, appeared to be uncommon in Flanders. There were some differences in farm type and management according to the type of group housing system used (Table 6). In contrast to farms with interval and ad libitum feeding, farms with a

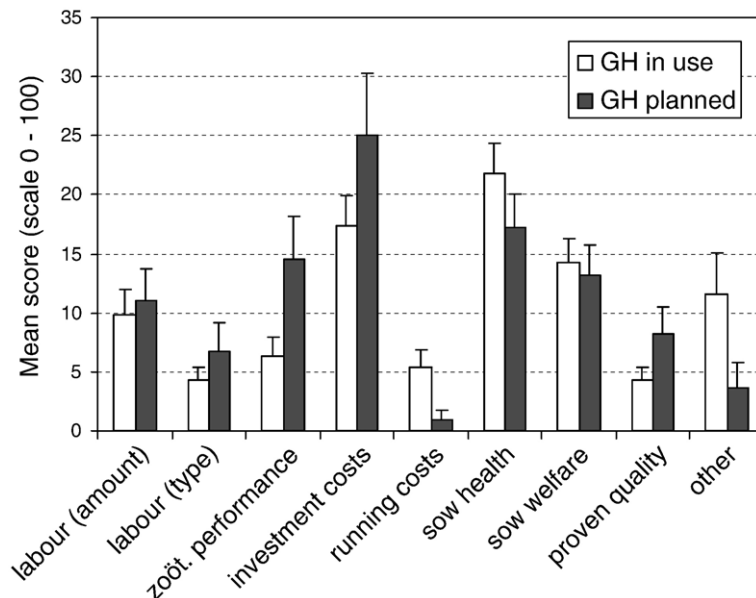


Fig. 2. The relative importance of various reasons for having chosen a specific group housing system as reported by farmers using such a system already (GH in use) or planning to build one within a time-span of two years (GH planned). The mean scores (+SE) are given on a 0–100 scale (respondents divided 100 points among the different reasons with more points indicating greater relative importance). Survey data from 2003 and 2005 are combined.

Table 6

Comparison between the seven group housing systems (2003 and 2005 survey data combined)

	Type of group housing system ¹						All types
	1	2	3	4	6 ²	7	
Mean age farmer (years)	40.4 (3.9)	45.5 (2.4)	48.1 (2.7)	44.4 (2.4)	40.0 (0)	50.7 (2.9)	46.0 (1.2)
Mean age of system (years)	6.6 (2.4) ^a	12.5 (1) ^a	13.8 (3.2) ^{ab}	6.1 (2) ^a	1.3 (0.7) ^a	25.2 (4.5) ^b	12.7 (1.5)
Mean likelihood successor ³	3.2 (0.3)	2.9 (0.3)	3.2 (0.4)	2.5 (0.3)	3 (0)	2.9 (0.4)	3.0 (0.1)
Mean no. of sows in herd	124 (15) ^{ab}	131 (11) ^{ab}	146 (39) ^{ab}	178 (19) ^a	247 (29) ^a	54 (19) ^b	134 (12)
% farrow to finish farms	55.5	66.6	64.7	64.3	100	53.8	63.4
% newly built system	25	88.9	44.4	55.6	33.3	63.6	57.8
Mean group size	9.4 (1.7) ^{ab}	41.5 (3.2) ^{bc}	14.6 (3.2) ^{ac}	34.6 (10) ^{bc}	11 (3) ^{abc}	6.7 (0.64) ^a	22.0 (2.8)
% dynamic groups	11.1 ^a	93.3 ^b	35.3 ^a	28.5 ^a	0 ^{ab}	23.1 ^a	39.4
% using straw	22.2	20.0	29.4	21.4	0	53.8	28.2
% providing enrichment	11.1	26.7	0	14.3	0	18.2	12.7
Mean floor space/sow (m ² /sow)	2.2 (0.2)	2.4 (0.2)	2.5 (0.2)	2.5 (0.3)	2.2 (0)	35.7 (33)	8.3 (5.8)
% using a 3-week system	55.5	20.0	17.6	21.4	100	0	23.9

The values are the means (and the standard error of the mean) or the percentages. Group housing systems with different superscript letters in the same row are significantly different ($P < 0.05$, Tukey multiple comparison).

¹See Table 1.

²Mean scores based on small sample size ($n = 3$).

³Scored on a scale from 1 (very unlikely) to 5 (very likely).

feeding stall/trough (type 7 in Tables 1 and 6) had a small number of sows. The latter group housing system has been in use for significantly longer than all other group housing systems with the exception of free access stalls. Systems with electronic feeding stations and ad libitum feeding systems used larger groups compared to systems with feeding stalls/troughs. On farms with electronic feeding stations sows were almost invariably kept in dynamic groups while static groups were used predominantly in the other group housing systems.

The main criteria for having chosen a particular type of group housing system related to the health and welfare of

the sows, the investment costs, and the amount of labour (Fig. 2). The more recent the group housing system was the greater the relative influence of economical reasons (LM, $F = 9.06$, $P = 0.004$). Farmers using drop/trickle and ad libitum feeding systems allocated more importance to the type of labour as a reason for having chosen their type of housing systems as compared to farmers using other group housing systems (LM, $F = 3.16$, $P = 0.013$).

On average, farmers using a group housing system reported to be rather satisfied with their system with regards to both the eight specific criteria and in general (Table 7). Summing all eight criteria to produce an

Table 7

Satisfaction scores on eight criteria separately and combined as reported by the users of the seven different group housing systems (2003 and 2005 survey data)

Criterion	Type of group housing system ¹						All types
	1	2	3	4	6 ⁴	7	
Labour (amount)	4.0 (0.3)	3.5 (0.3)	3.5 (0.2)	4.4 (0.2)	4.3 (0.3)	3.8 (0.3)	3.8 (0.1)
Labour (type)	3.9 (0.3)	3.8 (0.2)	3.8 (0.2)	4.1 (0.3)	4.0 (0.6)	4.0 (0.2)	3.9 (0.1)
Ease of use	4.3 (0.2) ^{ab}	3.4 (0.3) ^a	3.9 (0.2) ^{ab}	4.6 (0.1) ^b	4.7 (0.3) ^{ab}	4.5 (0.2) ^b	4.1 (0.1)
Sow welfare	4.0 (0.4)	3.7 (0.3)	4.1 (0.3)	4.5 (0.2)	4.0 (0.6)	4.4 (0.3)	4.1 (0.1)
Sow health	4.1 (0.4)	4.0 (0.3)	4.2 (0.2)	4.4 (0.2)	4.0 (0.0)	4.5 (0.2)	4.2 (0.1)
Zootechnical performance	4.2 (0.4)	4.0 (0.2)	3.8 (0.2)	4.0 (0.2)	3.7 (0.3)	4.2 (0.2)	4.0 (0.1)
Mechanics/electronics	4.3 (0.2) ^{ab}	3.5 (0.3) ^a	4.1 (0.2) ^{ab}	4.6 (0.2) ^b	4.0 (0.6) ^{ab}	4.8 (0.2) ^b	4.2 (0.1)
Running costs	4.4 (0.2) ^b	3.1 (0.3) ^a	3.9 (0.2) ^{ab}	4.3 (0.2) ^b	4.0 (0.0) ^{ab}	4.6 (0.2) ^b	4.0 (0.1)
General 1 ²	4.1 (0.3)	3.7 (0.2)	4.3 (0.1)	4.2 (0.2)	3.7 (0.3)	4.3 (0.2)	4.1 (0.1)
General 2 ³	4.2 (0.2) ^{ab}	3.6 (0.2) ^a	3.9 (0.1) ^{ab}	4.4 (0.1) ^b	4.1 (0.3) ^{ab}	4.3 (0.2) ^{ab}	4.1 (0.1)

The values are mean scores (and the standard error of the mean) on a scale from 1 (not at all satisfied) to 5 (very satisfied). Group housing systems with different superscript letters in the same row are significantly different ($P < 0.05$, Tukey multiple comparison).

¹See Table 1.

²General satisfaction as scored on a 1–5 scale by the respondents.

³Mean of the scores for the first eight criteria.

⁴Mean scores based on small sample size ($n = 3$).

overall satisfaction index, revealed that farmers using group housing for all sows were more satisfied than farmers using both group housing and individual stalls (LM, $t_{67}=3.53$, $P<0.001$) and that farmers were more satisfied with their group housing system in 2005 than 2003 (LM, $t_{67}=-2.08$, $P=0.04$). Farmers using an electronic feeding station tended to be less satisfied as compared to farmers using ad libitum feeding (LM, $t_{63}=-3.15$, $P=0.03$) or feeding stalls/troughs (LM, $t_{63}=-2.79$, $P=0.07$). More specifically, they reported to be less satisfied with the ease of use and the mechanics/electronics of their system.

4. Discussion

The combined postal–telephone survey among randomly selected pig farmers resulted in a very high response rate that is representative for Flemish pig farmers having at least two sows. A downside of this survey method is that some influence from the interviewees (on the more subjective questions in particular) cannot be ruled out.

The Flemish, and by generalisation the Belgian (as 88.5% of the Belgian pig farms with >1 sow are located in Flanders), pig industry still has a long way to go in order to comply fully with the EU ban on the individual housing of pregnant sows by 2013. In 2005, only 16% of the farmers had (some of) their pregnant sows housed in a group. In some other European countries, such as the Netherlands, the UK, Switzerland and Northern European countries, the percentage of farms with a group housing system increased faster and earlier, often as a result of national policies to promote group housing. For example, in the Netherlands the transition has been largely completed already as national legislation implemented the ban on confinement of gestating sows to individual stalls from 2008 onwards. Whereas in 1998 only about 5% of the total Dutch gestating sow population was held in a group housing system (Hendricks et al., 1998), the percentage of farms with a group housing system had risen steeply to an estimated 41% by 2002 (Ten Brinke et al., 2002). The percentage of farms with group housing is also lower in Belgium as compared to its other main neighbouring countries (40% in Germany: Hoy, 2001; 21% in France: Courboulay, 2003), the European average (30%: Hendricks et al., 1998) and many other countries outside Europe such as Australia (37%: Patterson et al., 1997), New Zealand (50%: Gregory and Devine, 1999) and the USA (30–40%: Barnett et al., 2001).

Moreover, only a small minority (7.4% in 2005) of the Flemish farmers had plans to convert to a group housing system within 2 years time. These tended to be

younger farmers and farmers of a big sow herd. Ten Brinke et al. (2002) also found that farmers with a successor and younger farmers are more willing to invest in new equipment and housing systems. However, a large proportion of these young large-scale farmers with a likely successor reported no plan to change to a group housing system yet because of the lack of financial resources and security. An increasing group of farmers (often without a successor) reported to delay changing to group housing for as long as possible because they prefer to house their sows individually, which they consider as more profitable. In contrast, for a substantial group of mainly older small-scale farmers without a successor the main reason for not planning to convert to group housing is that they will terminate their farming activities before 2013.

Yet, very few users of a group housing system seemed dissatisfied with their system. Farmers housing all their sows in group were more satisfied than farmers housing only some of their sows in group. Perhaps, those having fully changed are more committed to the new system and focussed on the best way to operate it. The most important reasons for having chosen a particular type of group housing system are related to the health and welfare of sows, the investment costs and the amount of labour. The relative weight of economic reasons has increased over time. This trend seems to continue as the relative importance of criteria such as investment costs and zootechnical performance was even greater for those who are planning to change to group housing, whereas the importance of sow health and welfare was smaller.

The combination of a time-consuming survey method and the small proportion of respondents using, or planning to change to, group housing implies that sample sizes were rather limited such that only cautious conclusions can be drawn about the prevalence and user opinion about specific group housing systems. It nevertheless appears that free access stalls (24%), electronic feeding stations (21%), ad libitum feeding (20%), feeding stalls/troughs (18%), and drop/trickle feedings systems (13%) are more common group housing systems in Flanders than interval feed dispensers and electronic feed dispensers. Although comparisons with other surveys are complicated because group housing systems have been categorised differently, free access stalls appear to be a more popular group housing system in Flanders than in France (Courboulay, 2003) or Germany (Hoy, 2001). The percentage of electronic feeding stations in Flanders is comparable to Germany (24%: Hoy, 2001), but higher than in France (17.5%: Courboulay, 2003) and lower than in the Netherlands (37%: Ten Brinke et al., 2002).

Although user satisfaction was not particularly higher than for other group housing systems (and in fact relatively low for criteria such as labour, ease of use and zootechnical performance), it seems that free access stalls will become even more popular in Flanders as 58% of the farmers with plans to convert from individual to group housing reported to opt for this system (data from 2003 and 2005 surveys combined). This system most closely resembles individual housing of sows in stalls and can often be achieved by modifying existing individual stalls. Free access stalls may require more labour than other feeding systems (especially if sows are hand-fed), however they enable the producer to lock the sows in for management procedures such as artificial insemination and vaccinations (Morrison, 2003). Furthermore, they enable a sow to feed (and rest) simultaneously without being disturbed by other sows. Typically all animals are fed the same amount, but individuals can receive additional feed by hand.

Electronic feeding stations are commonly used in newly built holdings and for sows in large dynamic groups. The popularity of this group housing system is expected to decrease in Flanders as only 6% of the farmers planning to convert indicated to opt for this system (2003 and 2005 data combined). It is often complex and costly to convert an individual housing system to this type of group housing system and also the type of management is very different (farmers have to teach new sows how to use the system, they have to use the PC more, etc.). Furthermore, user satisfaction in general seemed lowest for this type of group housing system. Some negative experiences concerning, for example, mechanical and electronic defects, loss of eartags, or more than one sow entering the electronic feeding station may relate predominantly to the first generation feeding stations (Van Gansbeke, 2006). Although experts considered good welfare possible both in group housing with and without electronic feeding station, housing systems with larger groups of sows are considered to be burdened by a higher management risk which may compromise animal welfare compared to systems with smaller groups of sows (Bartussek et al., 2000). Moreover, there are indications that the continual replacement of animals in dynamic groups (93% of the farms using electronic feeding system used dynamic groups) leads to higher levels of aggression, fear and stress resulting in poorer welfare and impaired reproduction (Simmins, 1993; Leeb et al., 2001; Kongsted, 2004). Other problems may be more inherent to the system. For example, electronic feeding stations allow only one sow to eat at a time, which may result in a highly competitive environment and possibly in injuries (Van Putten and van de Burgwal, 1990; Broom et al., 1995; Krause et al., 1997;

Geverink and Tuytens, 2007). Despite suggestions that it may reduce aggression and leg problems (Andersen and Bøe, 1999; Jensen, 2000; Tuytens, 2005), straw was provided in only one fifth of the farms with electronic sow feeders in Flanders.

Ad libitum feeding systems tend to be rather recent and are often used for large groups of sows. There is typically one feeding trough per 4 to 15 sows containing ad libitum bulky feed enriched with fibres. Although feeding costs and manure production per sow are higher than for other systems, user satisfaction was very high, confirming that this is an easy system to use and maintain, requiring little investment costs and labour, and resulting in good sow health and welfare (Van Gansbeke, 2006). Edwards et al. (1994) have also reported that the provision of ad libitum feed reduces agonistic behaviour and skin lesions in group housed sows.

Systems in which feed is manually (type 7) or automatically (drop/trickle feeding) distributed into long feeding troughs or – which appears to provide some welfare benefits in terms of reduced aggression (Petherick et al., 1987; Barnett et al., 1992) – partial feeding stalls are commonly used in Flanders for small groups of sows. The manual type is an older system often used on small farms. With the exception perhaps for concerns about the amount of labour, users reported to be very satisfied with this low-tech manual feed delivery system. Nevertheless, none of the surveyed farmers was planning to convert this type of group housing system anymore (whereas 13% opted for drop/trickle feeding).

Interval feed dispensers are modern systems that were used by only three respondents (2003 and 2005 surveys combined). All three used the Vario-mix system without individual recognition of sows (and hence without the possibility of individualised feeding rations). This system may become more popular in the future (9% of the farmers surveyed in 2005 reported to build this type of group housing system before 2007). Electronic feed dispensers that do allow rations to be individualised for each sow in the group (such as the Vario-mix system with individualised feeding rations, the Belados, and Fitmix system), however, were very rare in Flanders and this appears likely to remain so in the near future.

5. Conclusion

With only 16% of the farmers keeping some or all of their gestating sows in group housing in 2005 and another 7.4% planning to convert to group housing before 2007, the compulsory transition from individual to group housing systems is taking place very slowly in

Flanders as compared to its neighbouring and many other developed countries. In contrast to most of these countries, there have been few or no national policies (apart from the current possibilities for support from the Flemish Agricultural Investment Fund), and no major market forces, encouraging producers to convert to group housing before the EU deadline of 2013. The relative importance of the various reasons for not yet having planned to change to group housing differs according to the age of the farmer, the likelihood of having a successor and the size of the sow herd. About a quarter of all group housing systems in Flanders are free access stalls and the popularity of this system even appears to be increasing (at the expense of electronic feeding stations and manual feeding stalls/troughs). Despite the limited sample sizes, types of group housing systems used in Flanders were found to differ according to the size of the sow herd, the duration the system has been used, the group management (dynamic versus static groups), and user satisfaction.

This survey reveals that Belgian pig production is likely to undergo drastic changes during the few years remaining before the 2013 deadline and the socio-economic consequences for the Belgian pork industry may be considerable. Although this survey was specific for the Belgian situation, many findings (such as concerning user satisfaction and factors which affect decision making) are clearly relevant to livestock scientists as well as pig farmers from other countries using or planning to convert to a group housing system for their gestating sows.

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References

- Andersen, I.L., Bøe, K.E., 1999. Straw bedding or concrete floor for loose-housed pregnant sows: consequences for aggression, production and physical health. *Acta Agric. Scand., A Anim. Sci.* 49, 190–195.
- Backus, G.B.C., Vermeer, H.M., Roelofs, P.F.M.M., Vesseur, P.C., Adams, J.H.A.N., Binnendijk, G.P., Smeets, J.J.J., Van der Peet Schwing, C.M.C., Van der Wilt, F.J., Bottcher, F.J.R.W., Hoff, S.J., 1997. Comparative study of four housing systems for non-lactating sows. *Livest. Environ.* 5, 273–279.
- Barnett, J.L., Hemsworth, P.H., Cronin, G.M., Newman, E.A., McCallum, T.H., Chilton, D., 1992. Effects of pen size, partial stalls and method of feeding on welfare-related behavioural and physiological responses of group-housed pigs. *Appl. Anim. Behav. Sci.* 34, 207–220.
- Barnett, J.L., Hemsworth, P.H., Cronin, G.M., Jongman, E.C., Hutson, G.D., 2001. A review of the welfare issues for sows and piglets in relation to housing. *Aust. J. Agric. Res.* 52, 1–28.
- Bartussek, H., Bünger, B., Edwards, S., Haidn, B., Jensen, K.H., Krispel, F., van Putten, G., Steiger, A., Troxler, J., Weber, R., Wechsler, B., Vermeer, H., Wiedman, R., 2000. Group housing of dry sows. Report of the IGN-workshop 'Group Housing of Dry Sows', 9–11 September 1998. Gumpenstein, Austria.
- Bracke, M.B.M., Spruijt, B.M., Metz, J.H.M., 1999. Overall animal welfare reviewed. III. Overall welfare assessment of pregnant sow housing systems based on interviews with experts. *Neth. J. Agric. Sci.* 47, 93–104.
- Bracke, M.B.M., Spruijt, B.M., Metz, J.H.M., Schouten, W.G.P., 2002. Decision support system for overall welfare assessment in pregnant sows. A model structure and weighting procedure. *J. Anim. Sci.* 80, 1819–1834.
- Broom, D.M., Mendl, M.T., Zanella, A.J., 1995. A comparison of the welfare of sows in different housing conditions. *Anim. Sci.* 61, 369–385.
- Courboulay, V., 2003. Systèmes de logement en groupe des truies en gestation: résultats techniques et enquêtes en élevage (in French). Institut Technique du Porc (ITP), Rapport Etude, Le Rheu Cedex, France.
- Daelemans, J., 1998. De varkensstal: comfort voor dier en mens (in Dutch). In: Daelemans, J., Flaba, J. (Eds.), *Hygiëne en Comfort in de Varkensstallen*, Ministerie van Middenstand en Landbouw, Bestuur Onderzoek en Ontwikkeling, Brussels, pp. 15–25.
- De Letter, F., 2001. "9 op 10 Belgen vinden zeugenboxen weed", stelt GAIA na een opiniepeiling (in Dutch). *Varkensbedrijf* 247, 12–13.
- Den Hartog, L.A., Backus, G.B.C., Vermeer, H.M., 1993. Evaluation of housing systems for sows. *J. Anim. Sci.* 71, 1339–1344.
- Edwards, S.A., Mauchline, S., Marston, G.C., Stewart, A.H., 1994. Agonistic behaviour amongst newly mixed sows and the effects of pen design and feeding method. *Appl. Anim. Behav. Sci.* 41, 272.
- Geverink, N.A., Tuytens, F.A.M., 2007. On-farm evaluation of group-housing for sows. Proceedings of the 41st Congress of the International Society for Applied Ethology (ISAE), 30 July–3 August 2007. Mérida, Mexico, p. 201.
- Gonyou, H.W., 2003. Group housing: alternative systems, alternative management. *Adv. Pork Prod.* 14, 101–107.
- Gregory, N.C., Devine, C.D., 1999. Survey of sow accommodation systems used in New Zealand. *N.Z. J. Agric. Res.* 42, 187–194.
- Groenestein, C.M., Hol, J.M.G., Vermeer, H.M., Den Hartog, L.A., Metz, J.H.M., 2001. Ammonia emission from individual- and group-housing systems for sows. *Neth. J. Agric. Sci.* 49, 313–322.
- Hendricks, H.B.M., Pedersen, B.K., Vermeer, H.M., Whitmann, M., 1998. Pig housing systems in Europe: current distributions and trends. *Pig News Inf.* 19, 97N–104N.
- Hoy, S., 2001. Group housing pressure in the EU. *Pig Prog.* 17 (7), 10–14.
- Hulbert, L.E., McGlone, J.J., 2006. Evaluation of drop versus trickle-feeding systems for crated or group-penned gestating sows. *J. Anim. Sci.* 84, 1004–1014.
- Jensen, K.H., 2000. Management factors affecting activity and aggression in dynamic group housing systems with electronic sow feeding: a field trial. *Anim. Sci.* 71, 535–545.
- Kongsted, A.G., 2004. Stress and fear as possible mediators of reproduction problems in group housed sows: a review. *Acta Agric. Scand., A Anim. Sci.* 54, 58–66.
- Krause, M., van 't Klooster, C.E., Buré, R.G., Metz, J.H.M., Sambras, H.H., 1997. The influence of sequential and simultaneous feeding

- and the availability of straw on the behaviour of gilts in group housing. *Neth. J. Agric. Sci.* 45, 33–48.
- Leeb, B., Leeb, Ch., Troxler, J., Schuh, M., 2001. Skin lesions and callosities in group-housed pregnant sows: animal-related welfare indicators. *Acta Agric. Scand., A Anim. Sci. Suppl.* 30, 82–87.
- Marchant, J.N., Rudd, A.R., Broom, D.M., 1997. The effects of housing on heart rate of gestating sows during specific behaviours. *Appl. Anim. Behav. Sci.* 55, 67–78.
- Maton, A., Daelemans, J., Lambrecht, J., 1985. *Housing of Animals*. Elsevier, Amsterdam.
- McGlone, J.J., von Borell, E.H., Deen, J., Johnson, A.K., Levis, D.G., Meunier-Salaün, M., Morrow, J., Reeves, D., Salak-Johnson, J.L., Sundberg, P.L., 2004. Review: compilation of the scientific literature comparing housing systems for gestating sows and gilts using measures of physiology, behaviour, performance, and health. *Prof. Anim. Sci.* 20, 105–117.
- Morrison, R., 2003. Large group systems for gestating sows. *Proceeding of the Symposium on Swine Housing and Well-being* (ed. R. Reynnells), 5 June 2002. Des Moines, Iowa, USA, pp. 53–54.
- Patterson, R., Pointon, A., Cargill, C., 1997. Sow wastage in the Australian pig herd—degree, cost and prevention. Report to the Pig Research and Development Corporation, Canberra.
- Petherick, J.C., Boderio, D.A.V., Blackshaw, J.K., 1987. The use of partial barriers along the feed trough in a group housing system for non-lactating sows. *Farm Build. Eng.* 4, 32–36.
- Roelofs, P.F.M.M., Van de Sande Schellekens, A.L.P., 1996. Invloed van huisvestingssysteem op arbeid en arbeidsomstandigheden bij dragende zeugen (in Dutch). Research Institute for Pig Husbandry. Report P1.164, Rosmalen, The Netherlands.
- Scientific Veterinary Committee (SVC), 1997. The welfare of intensively kept pigs. Available from: http://europa.eu.int/comm/food/fs/sc/oldcomm4/out17_en.pdf.
- Simmins, P.H., 1993. Reproductive performance of sows entering stable and dynamic groups after mating. *Anim. Prod.* 57, 293–298.
- Ten Brinke, W., Fokker, W., Gerritsen, R., Keuken, E., van de Ven, L., 2002. Management of group housed sows. Research report, Nutreco, The Netherlands.
- Tuytens, F.A.M., 2005. The importance of straw for pig and cattle welfare: a review. *Appl. Anim. Behav. Sci.* 92, 261–282.
- Van Gansbeke, S., 2006. Groepshuisvesting van zeugen (in Dutch). Afdeling Duurzame Landbouwwontwikkeling, Departement Landbouw en Visserij, Vlaamse Overheid, brochure 43. Brussels, Belgium.
- Van Putten, G., van de Burgwal, J.A., 1990. Vulva biting in group-housed sows: preliminary report. *Appl. Anim. Behav. Sci.* 26, 181–186.
- Vermeer, H.M., Plagge, J.G., Hoofs, A.I.J., Roelofs, P.F.M.M., Spoolder, H.A.M., 2001. Groepshuisvesting voor gaste en drachtige zeugen (in Dutch). Themaboek Praktijkonderzoek Veehouderij, AD Lelystad, The Netherlands.